2.0 GLOSSARY/KEY TERMS

Central Valley Water Board – Central Valley Regional Water Quality Control Board (CVRWQCB)

IBP – Intensive Basin Program

ILRP- Irrigated Lands Regulatory Program

MCL- Maximum Contamination Level

MUN - Municipal and Domestic Supply

NPDES - National Pollutant Discharge Elimination System

SC- Specific Conductance

SJR – San Joaquin River

SWAMP – Surface Water Ambient Monitoring Program

State Water Board – State Water Resources Control Board

TKN- Total Kjeldahl Nitrogen

TOC- Total Organic Carbon

TSS-Total Suspended Solids

QA- Quality Assurance

QC- Quality Control

WY- Water Year

3.0 INTRODUCTION

The San Joaquin River Watershed Unit of the Central Valley Regional Water Quality Control Board (Central Valley Water Board) initiated a water quality monitoring program in October of 2000 as part of California Assembly Bill AB 982 (Chapter 495, Statutes of 1999). AB 982 focuses State Water Resources Control Board (State Water Board) efforts on developing a comprehensive ambient surface water quality monitoring program known as the Surface Water Ambient Monitoring Program (SWAMP).

At the Central Valley Water Board, SWAMP is attempting to answer the following overarching question and related sub-questions.

> What is/are the status and trends of ambient water quality in streams and rivers in the Sacramento River, San Joaquin River, and Tulare Lake Basins?
>
> --Are there spatial and temporal trends in water quality?
> --What is the location and extent of various levels of water quality?
> --Is there evidence of beneficial use impairment?
>
> (and over the long-term)
>
> --Is water quality getting better or worse?
> --Are Board programs (regulatory/non-regulatory) and management actions effective?

The SWAMP for the San Joaquin River (SJR) Basin (Figure 1) is built upon a monitoring framework developed as part of the agricultural subsurface drainage management program that focuses on selenium, salt and boron and has evolved since 1985 (discussed in more detail in section 4.0). The current SWAMP program contains 3 tiers. The first tier is a selection of sites along the main stem of the river, downstream of major inflows. The second tier is a series of sites representing inflows from specific sub-watersheds into the main stem of the river (drainage basin inflows component). These first two tiers consist of long term trend sites where monitoring is conducted weekly to monthly, depending on site and constituent.

The final tier, the Intensive Basin Monitoring Program (IBP), is a more detailed, yearlong survey of the water quality within each of six sub-watersheds once every 5-years. Each of these sub-basins included water bodies with similar hydrologies, geologies, management issues, land use and land cover. The sixth basin, the southern Sacramento – San Joaquin Delta (South Delta), has not been included as part of the rotation due to the extensive monitoring and modeling already conducted by other agencies. A detailed discussion of the design of the 3-tier monitoring program is presented in section 6.2.

This study focuses on the results for the first two tiers of the effort, the main stem San Joaquin River and inflows from sub-watersheds, between October 2000 and September 2005. Prior to initial water quality sampling, state, federal, and local agencies as well as known watershed groups were surveyed to identify current monitoring efforts and local concerns. These contacts included but were not limited to the Department of Water Resources, Department of Fish and Game, University of California, US Geological Survey, US Environmental Protection Agency, US Fish and Wildlife Service, Natural Resources Conservation Service, CalFed, San Luis Delta-Mendota Water Authority, Grassland Area Farmers, local Resource Conservation Districts, and groups receiving water quality improvement bond grants.

Concerns were varied, but most consistently included potential impacts to aquatic life and recreation, in particular concerns with temperature, sedimentation, selenium, off-site movement of pesticides, and pathogens, with additional concerns of irrigation supply (elevated salt) and drinking water (elevated total organic carbon). The final sampling design incorporated the survey findings as funding permitted. At a minimum, each site was analyzed for standard field measurements (SC, pH, temperature, turbidity, and DO) as well as total coliform and *E. coli*. Monthly photo documentation was taken at each site. Sampling expanded to include total organic carbon, total suspended sediments, trace elements (arsenic, copper, chromium, lead, nickel, zinc, selenium, molybdenum, and mercury), biochemical oxygen demand, mineral data (chloride, sulfate, calcium, magnesium, total dissolved solids, carbonate, bicarbonate, total alkalinity and sodium) and water column toxicity when additional funding was available.

Data gathered over the five year period provides information on the spatial and temporal trends in water quality and preliminary indications on potential beneficial use impairments. Key beneficial uses evaluated and the indicators utilized are listed below.

- Drinking Water (Salt/Specific Conductance, Total Organic Carbon, Trace Elements, Nutrients, *E. coli*)
- Aquatic Life (Toxicity, Temperature, Dissolved Oxygen, Trace Elements, Ammonia, pH)
- Recreation (*E. coli)*
- Irrigation Supply (Salt/Specific Conductance)

Details for overall SWAMP monitoring objectives and indicators, as well as data for expanded subbasin monitoring and the selenium control program, can be found on the Central Valley Regional Water Quality Control Board SWAMP website at:

http://www.swrcb.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/sjr_swamp.shtml

Since 2003, all data collected as part of the San Joaquin River SWAMP effort that met quality assurance requirements, has been posted annually at the above website.

Figure 1: San Joaquin River Basin

4.0 BACKGROUND

In 1985, an extensive water quality survey to evaluate the impacts of agricultural drainage on the lower San Joaquin River (SJR) was initiated. Although a number of issues of concern were identified, salt, boron and selenium impacts were the priority and a resulting multi-agency water quality monitoring program was created focusing its limited resources on evaluating these constituents. The area has since been the focus of the Region's subsurface agricultural drainage program and considerable staff effort and resources have been directed to the effort of developing a comprehensive monitoring program, ensuring stakeholder involvement, and adopting Basin Plan Amendments and Waste Discharge Requirements in order to develop a workable and comprehensive selenium control program.

The compliance monitoring portion of this effort is the responsibility of the Data Collection and Reporting Team (DCRT) whose members include representatives from the US EPA, US Geological Survey, US Bureau of Reclamation, US Fish and Wildlife Service, CA Department of Fish and Game, Central Valley Water Board, and Grassland Area Farmers. The DCRT monitoring program evaluates selenium concentrations, loading, and potential impacts in water, sediment, and biota. Water quality analyses for selenium salt and boron are conducted at nine sites within the Grassland Watershed and seven sites along the main stem of the SJR. Grab samples are collected weekly, with daily composites also collected at two key sites: the consolidated agricultural subsurface drainage discharge point on the San

Luis Drain; and at Crows Landing on the SJR. (See Grassland Bypass Program on the Central Valley Regional Board SWAMP website for more detailed information.) The SJR SWAMP program was built upon this established framework.

Basin priorities include maintaining the Grassland Bypass Program and expanding it to facilitate real-time monitoring activities. Other issues of concern include: aquatic toxicity from waterborne pesticides; aquatic life impacts from pesticides in bed sediment; habitat impacts from sedimentation; elevated nutrient and BOD levels; pathogens; elevated temperatures; impacts from abandoned mines, timber harvesting and grazing; and establishing baseline condition in rural Coastal Range streams in areas slated for future urban development.

5.0 STUDY AREA

5.1 San Joaquin River Hydrology

The San Joaquin River (SJR) is the principal drainage artery of the San Joaquin Valley. The basin covers 17,720 square miles (CVRWQCB, 1998) and yields an average annual surface runoff of about 1.6 million acre-feet. The SJR basin drains the portion of the Central Valley south of the Sacramento-San Joaquin Delta and north of the Tulare Lake Basin.

The lower Basin (below Millerton Reservoir) has had a highly managed hydrology since implementation of the Central Valley Project (CVP) in 1951. From the Sierra Nevada, the river channel drains westward to the Mendota Pool near the town of Mendota. As the river channel continues past the Mendota Pool it turns northward to narrow by the constrictions of the Merced River and Orestimba Creek alluvial fans. From there, the river channel makes its way north to the Sacramento-San Joaquin Delta and out to the Suisun Bay.

Most of the flow released from Friant Dam is diverted into the Friant-Kern Canal, leaving the river channel upstream of the Mendota Pool dry except during periods of wet weather flow and major snow melt, which was the case in early 2005. The majority of the water in the Mendota Pool has been transported from the Delta via the Delta Mendota Canal (DMC) for irrigation use and to replace water lost thru diversion of the upper SJR flows. The majority of that poorer quality (higher salinity) water is then discharged to irrigation supply channels along the west side of the river, while some flows are released to the main river channel and continue to Sack Dam. Remaining flows not diverted for agricultural use out of the main channel are then diverted at Sack Dam leaving flows in the lower San Joaquin River (below Sack Dam) mainly dependent on releases from upstream reservoirs, agricultural return flows, and groundwater seepage, although wetland releases and storm water run-off can have considerable impacts on the flows as well. During the irrigation season, the flows in the river between Sack Dam and Salt Slough consist largely of groundwater accretions.

Salt Slough and Mud Slough (north) are the principal drainage arteries for the Grassland Sub-Basin and add significantly to the flows and waste loads in the SJR upstream of its confluence with the Merced River. Eastside discharges dominate flows in the SJR, as higher quality (lower salinity) water is released from reservoirs on the Merced, Tuolumne, and Stanislaus Rivers. Flows from the west side of the river basin are dominated by agricultural return flows since west side streams are ephemeral and their downstream channels are used to transport agricultural return flows to the main river channel (Steenson, *et al.*, 1998)

The principal streams in the basin are the San Joaquin River and its larger tributaries: the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers which all drain the east side of the basin. Major land use along the San Joaquin Valley floor is agricultural, occupying approximately 2.0 million acres, representing approximately 23% of the irrigated acreage in California (DWR, 2001). Urban growth along the I-5 corridor between Fresno and Stockton is rapidly converting historical agricultural lands to urban areas. As more and more people choose to commute from the Central Valley to the Bay Area, the rapid conversion of land is leading to increasing potential for storm water and urban impacts to local waterways. Timber activities, grazing, abandoned mines, rural communities, and recreation can impact upper watershed areas (Graham, 2009).

5.2 San Joaquin River Sub-Basins

To help characterize the SJR watershed and develop a monitoring program targeting specific problems affecting water quality, the watershed was broken into six smaller sub-basins bound by the Sierra Nevada Mountains or the Coastal Range and comprised of similar land use and drainage patterns (Figure 2). All of the agricultural-dominated and constructed water bodies within each of the sub-basins have been identified (Chilcott, 1992), as well as the potential water quality concerns and major representative discharges to the lower SJR. These sub-basins are similar to and based on, Total Maximum Daily Load (TMDL) efforts for salinity and boron in the lower SJR.

1. The **Northeast Basin** consists of the Cosumnes, Mokelumne, and Calaveras River Watersheds, providing a combined drainage of 4,360 square miles.

2. The **Eastside Basin** contains the three largest SJR tributaries, in terms of flow: the Merced, Stanislaus, and Tuolumne River Watersheds, along with the Farmington Drainage Basin and the lower Valley Floor Drainage Area, which drain directly to the SJR. The Eastside Basin is approximately 6,091 square miles.

3. The **Southeast Basin** is approximately 4,338 square miles and reaches from the headwaters of the SJR north to the watershed divide between Bear Creek and the Merced River in Merced County.

4. The **Westside Basin** encompasses the watersheds of the creeks draining the eastern slope of the Coast Range from the Orestimba watershed in the south to the Lone Tree Creek in the north. The Westside Basin is approximately 670 square miles.

5. The **Grasslands Basin** is a valley floor sub-basin of the SJR Basin, south of the Orestimba watershed, covering approximately 1,360 square miles. This basin lies on the west side of the SJR in portions of Merced, San Benito, and Madera Counties.

6. The **South Delta Basin** covers approximately 677 square miles and includes creeks on the northwest side of the SJR, as well as the southern portion of the Sacramento-San Joaquin Delta waterways down toward the confluence of the SJR and the Sacramento River. Waters inside the Delta boundaries are tidally influenced and typically higher in salinity than other surface water throughout the SJR Basin.

Figure 2: San Joaquin River Sub-Basins

6.0 SAMPLING PROGRAM

6.1 Program Objectives

In keeping with the overall Central Valley Regional Board SWAMP goals of being able to answer water quality questions related to spatial and temporal trends as well as whether or not there is evidence of beneficial use impairment, the following objectives were adopted for this effort:

1. Spatial and Temporal Trends
    a. Spatial includes the evaluation of the SJR moving progressively downstream as well as comparisons between sub-basins
    b. Temporal includes seasonal variations and annual variations (by water year type)
2. Evaluation of Beneficial Use Protection
    a. Using selected indicators to determine whether there is evidence of impairment
3. Utilizing information gathered from the long-term trend sites within each sub-basin to help direct future monitoring program design within that sub-basin.

6.2 Design

The SJR SWAMP program was designed as a trend-monitoring program that used a tiered approach. By using a tiered approach the SJR SWAMP program was able to adjust sampling constituents and monitoring frequencies to coincide with the year-to-year fluctuations in funding, as well as adjust for time delays associated with contracting to analytical laboratories. The use of available funds was then prioritized based on these tiers and the objectives of the program. This design resulted in less interruption to monitoring activities that were considered higher priority for the program. Creating a tiered monitoring design and selecting long-term sites and constituents also allows for the monitoring data to be evaluated over different water year types and facilitates assessment of implementation efforts going on throughout the valley. Monitoring sites for this program were selected from information gathered through existing monitoring efforts, historic data sets, the *Inland Surface Waters Plan* (Chilcott, J.,1992), the report *Water Diversion and Discharge Points Along the San Joaquin River* (James, E. W., *et al.*,1989), and reconnaissance done by Regional Board staff prior to initiation of any monitoring efforts.

The first tier of the program is the Main Stem Program. In that program, eight sites were selected along the lower section of the SJR and monitored on a daily, weekly, monthly, or quarterly basis, depending on the constituent. Those sites were selected as long-term sites and are located downstream of major influences to the river. Those sites were the most important to the program since they represent the "bottom" of the system and could show potential changes to the river over time. Many of the sites selected were already being monitored as part of the Grassland Bypass Program (multi-agency selenium control effort), so coordination with those monitoring and data management efforts was incorporated.

The second tier of the program is the Sub-Basin Program. The Sub-Basin Program moved the monitoring away from the main stem of the SJR and up into lower sections of the valley floor. In this program, 29 sites were selected as long-term trend sites representing the main inflows to the SJR from each of six sub-basins.

The third tier, the Intensive Basin Program, was not directly part of the trend monitoring, but rather focused on a 5-year rotational approach. This program contained approximately 20 sites per sub-basin, in addition to sites already part of the Sub-Basin Program, and focused solely on one sub-basin at a time. Sites selected within a sub-basin were monitored for one year, with the intent to rotate through the sub-basins once every 5 years.

To evaluate potential impact to beneficial uses, indicators were chosen for five broad beneficial uses: drinking water; recreation (swimming); aquatic life; irrigation; and waterfowl. The choice of indicators came from an evaluation of USEPA EPIC indicators (USEPA, 2003), water quality objectives and goals, and the fact that many of the indicators monitored as part of the SJR SWAMP efforts support high priority region-wide program assessments as listed in the 2005 Triennial Review of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. Regional programs utilizing SJR SWAMP monitoring data include: Drinking Water Policy, Water Quality Objectives for Bacteria Indicators, Salinity and Boron TMDL, Central Valley Salinity Policy Development, Erosion/Sediment guidelines, and SJR Dissolved Oxygen TMDL.

In general, the first five years of the program were set-up to continually monitor sites on the SJR as part of the main stem program on a weekly basis, monthly for certain constituents, with the Sub-Basin sites being monitored on a monthly basis. The remaining funding was utilized in the Intensive Basin Program. At the end of Water Year 2002 (i.e., 30 September 2002), a preliminary evaluation of the data collected as part of the first two years of the program was done and showed that the monthly monitoring frequency for nutrients, trace metals, minerals and TSS was not sufficient to develop useful trend information due to insufficient funding. Those analyses were then dropped from the program for a majority of the sites (mainly the Sub-Basin sites). Table 1 lists the monitoring sites and sampling frequencies associated with the constituents monitored for each site.

As funding permitted, samples were collected for: total suspended solids (TSS); total organic carbon (TOC); total coliform; *E. coli*; nutrients, including nitrate, nitrate-N, total kjeldahl nitrogen (TKN), ammonia, phosphorus, ortho-phosphate, and potassium; biochemical oxygen demand (5 and 10 day); chloride; sulfate; calcium; magnesium; total dissolved solids (TDS); carbonate; bicarbonate; total alkalinity; sodium; water column toxicity [*Pimephales promelas* (*P. promelas*), *Ceriodaphnia dubia* (*C. dubia*), *Selenastrum capriconutum* (algae)]; hardness; arsenic; cadmium; chromium; copper; lead; nickel; zinc; and mercury.

Figure 3 displays the distribution of the sites within the SJR Basin. For more information on the monitoring sites location including specific sampling location, summary of land-use, available water quality information, and monthly photograph documentation over the course of WY 2004-2005 for each site see Appendix I-O or refer to the central valley water quality web site:

http://www.swrcb.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/sjr_swamp.shtml

The results presented in this report focus on the first and second tier monitoring of the SJR SWAMP effort. Reports on the first three Intensive Basin Programs (Northeast Basin, Eastside Basin, and Westside Basin), the third tier of the program, as well as all water quality data can be found at:

http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/

Figure 3: Monitoring Site Locations

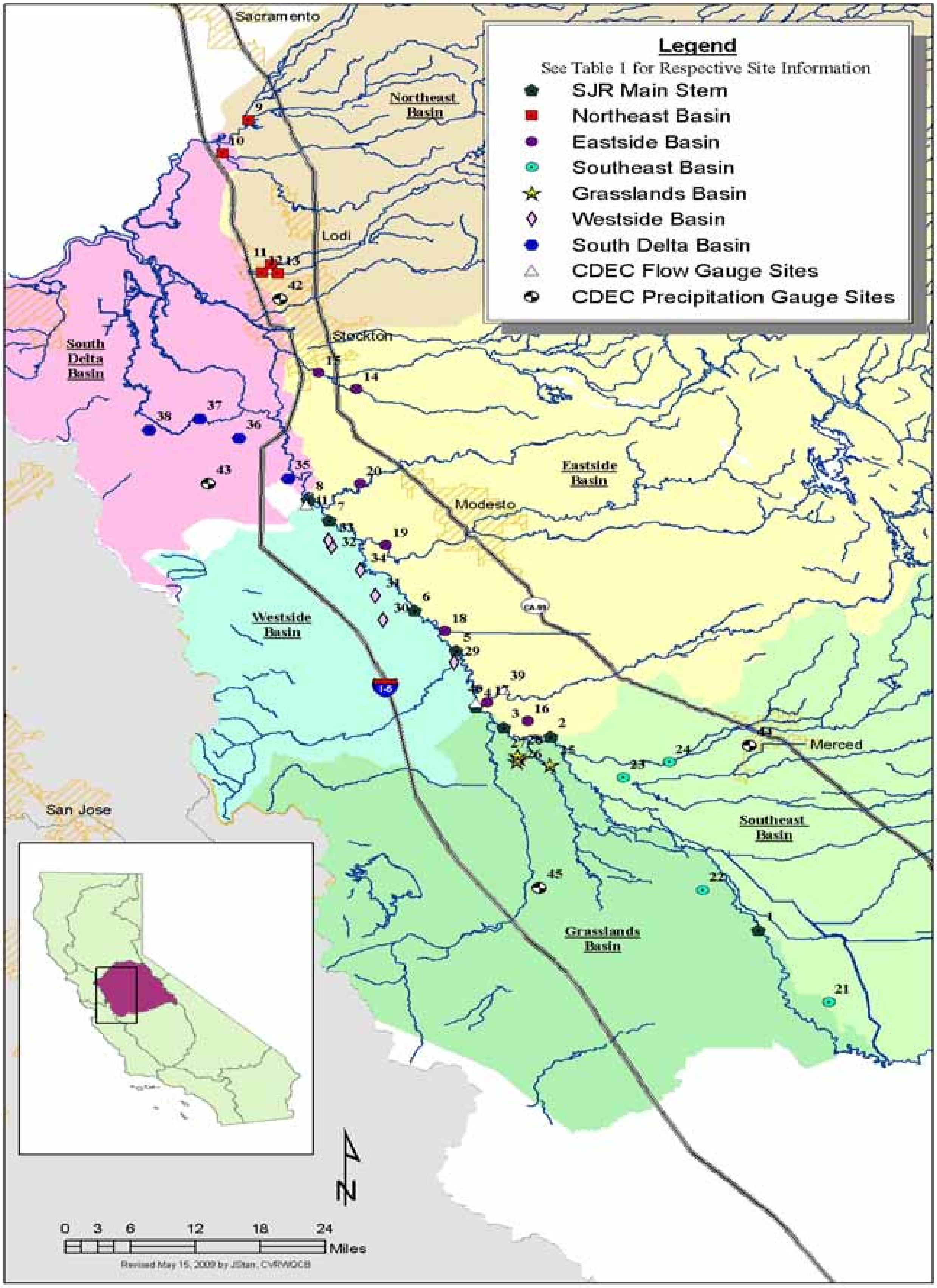


Table 1: SJR SWAMP Station Information and Sampling Frequencies*

Corresponding Map Number	Station Name	Station Code	Water Body Type	Target Lat	Target Long	SC (specific conductance)	pH	DO (dissolved oxygen)	Temp	*E.coli*	Total Coliform	TOC (total organic carbon)	TSS (total suspended solids)	Nutrients +	Trace Metals (Total & Dissolved)	Minerals **	Chronic Toxicity	Acute Toxicity	BOD (biochemical oxygen demand)
	Main Stem																		
1	SJR @ Sack Dam	541MAD007	R	36.98361	-120.50027	M	M	M	M	M	M	M	M	M	M	M			M
2	SJR @ Lander Avenue	541MER522	R	37.29527	-120.85027	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
3	SJR @ Fremont Ford	541MER538	R	37.30944	-120.92916	W	W	W	W	M+	M+	W	W	M	M	M			M
4	SJR @ Hills Ferry	541STC512	R	37.3425	-120.97722	M	M	M	M	M	M	M	M	M	M	M	M	M	M
5	SJR @ Crows Landing	535STC504	R	37.43194	-121.01166	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
6	SJR @ Patterson	541STC507	R	37.49777	-121.08166	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
7	SJR @ Maze	541STC510	R	37.64194	-121.22777	W	W	W	W	M+	M+	W	W	M	M	M			M
8	SJR @ Airport Way	541SJC501	R	37.67555	-121.26416	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
	Drainage Basin																		
	Northeast Basin																		
9	Cosumnes River at Twin Cities Road	531SAC001	ER	38.29083	-121.37583	M	M	M	M	M	M	M	M	M	M	M		M	M
10	Mokelumne River at New Hope Road	544SAC002	ER	38.23611	-121.41889	M	M	M	M	M	M	M	M	M	M	M		M	M
11	Pixley Slough at Davis Road	531SJC507	Eph/SL	38.05611	-121.33305	M	M	M	M	M	M	M	M	M	M	M		M	M
12	Bear Creek at Thornton Road (J8)	544SJC508	Eph/SL	38.04305	-121.34861	M	M	M	M	M	M	M	M	M	M	M			M
13	Bear Creek at Lower Sacramento Road	531SJC515	Eph/SL	38.04277	-121.32139	M	M	M	M	M	M	M	M	M	M	M		M	M
	Eastside Basin																		
14	Lone Tree Creek at Austin Road	531SJC503	Eph	37.85555	-121.185	M	M	M	M	M	M	M	M	M	M	M		M	M
15	French Camp Slough at Airport Way	531SJC504	SL	37.88166	-121.24944	M	M	M	M	M	M	M	M	M	M	M		M	M
16	Turner Slough at Fourth Ave.	535MER576	Eph/SL	37.32055	-120.88916	M	M	M	M	M	M	M	M	M	M	M		M	M
17	Merced River @ River Road	535MER546	ER	37.34972	-120.95777	M	M	M	M	M	M	M	M	M	M	M		M	M
18	TID 5 Harding Drain @ Carpenter Road	535STC501	Eph	37.46444	-121.03028	M	M	M	M	M	M	M	M	M	M	M		M	M
19	Tuolumne River at Shiloh Fishing Access	535STC513	ER	37.60305	-121.13166	M	M	M	M	M	M	M	M	M	M	M		M	M
20	Stanislaus River at Caswell Park	535STC514	ER	37.7025	-121.17722	M	M	M	M	M	M	M	M	M	M	M		M	M
	Southeast Basin																		
21	Lone Willow Slough at Road No. 9	545MAD006	Eph	36.86694	-120.38194	M	M	M	M	M	M	M	M	M	M	M			M
22	Santa Rita Slough at HWY 152	541MER015	Eph	37.0475	-120.59361	M	M	M	M	M	M	M	M	M	M	M			M
23	Deep Slough at Green House Road	535MER577	Eph	37.22972	-120.72833	M	M	M	M	M	M	M	M	M	M	M			M
24	Bear Creek near Bert Crane Road	535MER007	Eph	37.25555	-120.65194	M	M	M	M	M	M	M	M	M	M	M		M	M

Table 1: SJR SWAMP Station Information and Sample Frequencies* continued...

Corresponding Map Number	Station Name	Station Code	Water Body Type	Target Lat	Target Long	SC (specific conductance)	pH	DO (dissolved oxygen)	Temp	E.coli	Total Coliform	TOC (total organic carbon)	TSS (total suspended solids)	Nutrients +	Trace Metals (Total & Dissolved)	Minerals **	Chronic Toxicity	Acute Toxicity	BOD (biochemical oxygen demand)
Grasslands Basin																			
25	Salt Slough @ Lander Avenue	541MER531	Eph	37.24861	-120.85111	M	M	M	M	M	M	M	M	M	M	M	M	M	M
26	Mud Slough Upstream of SLD Terminus	541MER536	Eph	37.25416	-120.90694	M	M	M	M	M	M	M	M	M	M	M			M
27	San Luis Drain @ Terminus	541MER535	SD	37.25944	-120.90388	M	M	M	M	M	M	M	M	M	M	M			M
28	Mud Slough @ San Luis Drain	541MER542	Eph	37.26388	-120.90611	M	M	M	M	M	M	M	M	M	M	M			M
Westside Basin																			
29	Orestimba Creek @ River Road	541STC019	Eph	37.41388	-121.01416	M	M	M	M	M	M	M	M	M	M	M		M	M
30	Salado Creek at HWY 33	541STC515	Eph	37.48138	-121.13555	M	M	M	M	M	M	M	M	M	M	M		M	M
31	Del Puerto Creek at Vineyard Avenue	541STC516	Eph	37.52138	-121.14861	M	M	M	M	M	M	M	M	M	M	M		M	M
32	Ingram Creek at River Road	541STC040	Eph	37.60027	-121.22416	M	M	M	M	M	M	M	M	M	M	M		M	M
33	Hospital Creek at River Road	541STC042	Eph	37.61055	-121.22861	M	M	M	M	M	M	M	M	M	M	M		M	M
34	Grayson Road Drain at Grayson	541STC030	Eph	37.56194	-121.17416	M	M	M	M	M	M	M	M	M	M	M		M	M
Delta Basin																			
35	New Jerusalem Tile Drain	544SJC001	SD	37.70888	-121.29861	M	M	M	M	M	M	M	M	M	M	M		M	M
36	Tom Paine Slough at Paradise Road	544SJC505	SL	37.77416	-121.38222	M	M	M	M	M	M	M	M	M	M	M			M
37	Old River at Tracy Blvd.	544SJC506	SL	37.80472	-121.44944	M	M	M	M	M	M	M	M	M	M	M			M
38	Mt. House Creek @ Mt. House Parkway	544SJC509	Eph	37.78555	-121.53472	M	M	M	M	M	M	M	M	M	M	M		M	M
	CDEC Gauging Station Sites																		
39	Merced River Near Stevinson (Flow)	MST	NA	37.37100	-120.93100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
40	SJR near Newman (Flow)	NEW	NA	37.35000	-120.97700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
41	SJR Near Vernalis (Flow)	VNS	NA	37.66700	-121.26700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
42	Stockton Fire Station 4 (Precipitation)	STK	NA	38.00100	-121.31700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
43	Tracy Carbona (Precipitation)	TCR	NA	37.70000	-121.43300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
44	Merced (Precipitation)	MFS	NA	37.28300	-120.51700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
45	Los Banos (Precipitation)	LSB	NA	37.05000	-120.86700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

* Sample frequencies shown indicate frequency of samples taken as funding allowed

+ Nutrient analysis includes nitrate, nitrate-N, total kjeldahl nitrogen (TKN), ammonia, phosphorus, ortho-phosphate, and potassium

** Mineral analysis includes chloride, sulfate, calcium, magnesium, total dissolved solids, carbonate, bicarbonate, total alkalinity and sodium

W = weekly

M = Monthly

M+ = 2X/Month

R = Main Stem River

ER = Eastside River Draining Sierra

Eph = Ephemeral Stream usually dominated by AG return flows during irrigation season

SL = Backwater or Slough that can experience tidal influences

SD = Subsurface Drainage (shallow groundwater)

NA = Not Applicable

6.3 Sampling Procedures

All samples were measured and collected in compliance with the *Agricultural Subsurface Drainage Program Procedures Manual* (Chilcott, *et al.*, 1996) and the *Quality Assurance Program Plan for the State of California's Surface Water Ambient Monitoring Program "SWAMP"* (SWRCB, 2002*).*

Field measurements for temperature, specific conductance, pH, dissolved oxygen and turbidity were taken using one of three meters; Myron 6P Ultra Meter II (temp, SC, and pH only, Oct 2000- July 2001) Yellow Springs Instrument (YSI) 600 XLM Sonde (no turbidity), or a YSI 6600 Sonde (turbidity). All YSI readings were read from YSI 650 data logger.

Clean sample containers were rinsed three times with ambient water prior to grab sample collection, except for sample containers that were pre-acidified (ammonia and TOC) or contained other neutralizing agents (sodium thiosulfate for total coliform and *E. coli*). Water for pre-acidified samples was collected in a stainless steel cup or a sample bottle that was being collected for a separate constituent at the same site and poured into the sample container. All samples were kept at 4 degrees Celsius by storing them on ice after collection and during transport and in a refrigerator while in-house.

Appendix H lists the laboratories, detection levels, holding times and acceptable recoveries for the parameters monitored.

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

All quality assurance (QA) and quality control (QC) log-books for the constituents analyzed by outside laboratories were maintained by the Regional Board contract manager or their designee. QA/QC records for bacteria analysis and equipment maintenance are recorded in the respective QA/QC logbooks, found in the Central Valley Water Board laboratory where samples were analyzed.

At a minimum, field sampling equipment was calibrated as per manufacturer's instructions at the start and end of each sampling event and/or after 10-15 sites. If it was found that calibrations were off, the instruments were recalibrated and if needed, measurements re-taken.

Field and handling contamination was evaluated by submitting blind travel blanks on a monthly basis, and on each run for bacteria monitoring. Travel blank samples traveled through the sampling run, and were processed with the sample set. For most constituents, the travel blank consisted of a sample of de-ionized (DI) water that was produced at the Central Valley Water Board laboratory. For bacteria monitoring, the travel blanks were prepared by the Department of Plant Sciences, University of California Davis (UC Davis). After thorough discussion with UC Davis, the travel blanks were initially preparations of boiled deionized water and NaCl, which was then switched to Type II water in July 2002, and ultimately, phosphate buffered saline was added to the Type II water travel blanks at the end of WY 2005. For toxicity monitoring, Sierra Foothill Labs, Inc provided de-mineralized water (DMW) to be used for travel blanks. All data sets used for this report had travel blank results that fell below the analytical detection limits for the elements of concern.

Consistency in sample collection and analysis was evaluated by collecting replicate samples for all samples needing laboratory analysis. The Central Valley Water Board San Joaquin River Watershed Unit uses a SWAMP compliant standard quality assurance procedure that includes 10% replicate samples.

Precision and accuracy were evaluated using blind split and spiked samples. Blind split samples were collected at a 10% frequency for each sampling event by collecting the sample in a container double the normal sample volume and splitting that sample into two equal amounts for submittal to the analyzing laboratory. On a monthly basis, and when appropriate, half of the blind split samples were spiked with known concentrations of constituents to be analyzed. Comparing the spiked split to the background split provided information on analytical accuracy. Comparing data from non-spiked splits provided information on analytical precision.

Potential contamination from the reagent grade nitric acid used to control pH was evaluated by submitting a deionized water matrix preserved with 1 mL of acid per 500 mL of sample, to the contract laboratories at monthly intervals to be analyzed for the trace elements of concern. All reported recoveries for these acid check samples were below the analytical detection limit.

Only data from sample sets whose blind QA/QC met specifications outlined in Appendix H have been included in this report. These specifications are consistent with the QAPP for this program.

8.0 PRECIPITATION AND FLOW: WATER YEARS 2000-2005

The San Joaquin River is the principal drainage artery of the San Joaquin Valley, draining the area south of the Sacramento-San Joaquin Delta and north of the Tulare Lake Basin, approximately 13,500 square miles (Graham, 2009; Steensen, *et al.,* 1998). Precipitation varies throughout the SJR Watershed and occurs as both rainfall and snow. Mean annual precipitation on the valley floor ranges from less than 5 inches in the south to 15 inches in the north. Average annual precipitation in the Sierra Nevada, mostly in the form of snow, ranges from about 20 inches in the lower foothills to more than 80 inches at some higher altitude sites. Precipitation in the Coast Ranges varies from less than 10 inches to more than 20 inches. As in the valley, precipitation in the Sierra Nevada and Coast Ranges increases from south to north (Dubrovsky, *et al*., 1998).

> The San Joaquin River Index, as described in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary is used to classify the water year type in the river basin based on runoff. The 60-20-20 Index includes five classifications: wet, above normal, below normal, dry, and critical, based on millions of acre-feet of calculated unimpaired flow. (SWRCB, 1995)

A Water Year begins 1 October and ends 30 September of the following year. Because of the timing of this study, October 2000 through September 2005, five full water years are represented. Table 2 lists the Water Year Classifications based on rainfall and snow totals in the SJR Watershed during the project.

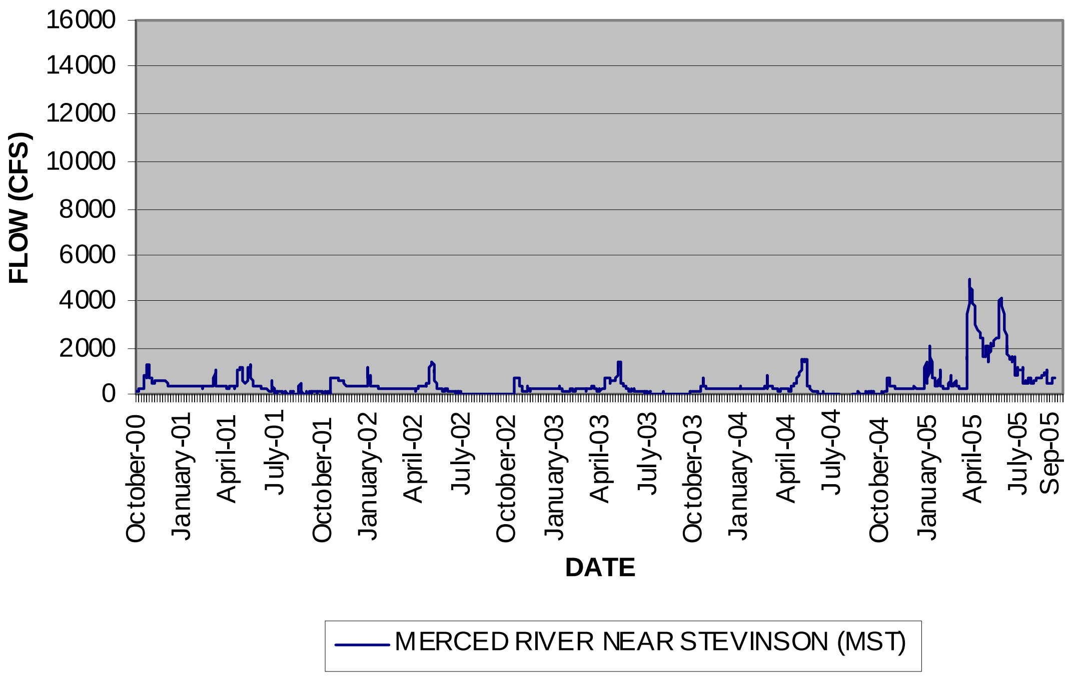
Table 2: Water Year Classifications

Water Year 2001 – Dry
Water Year 2002 – Dry
Water Year 2003 – Below normal
Water Year 2004 – Dry
Water Year 2005 – Wet

(Data source DWR, 2007)

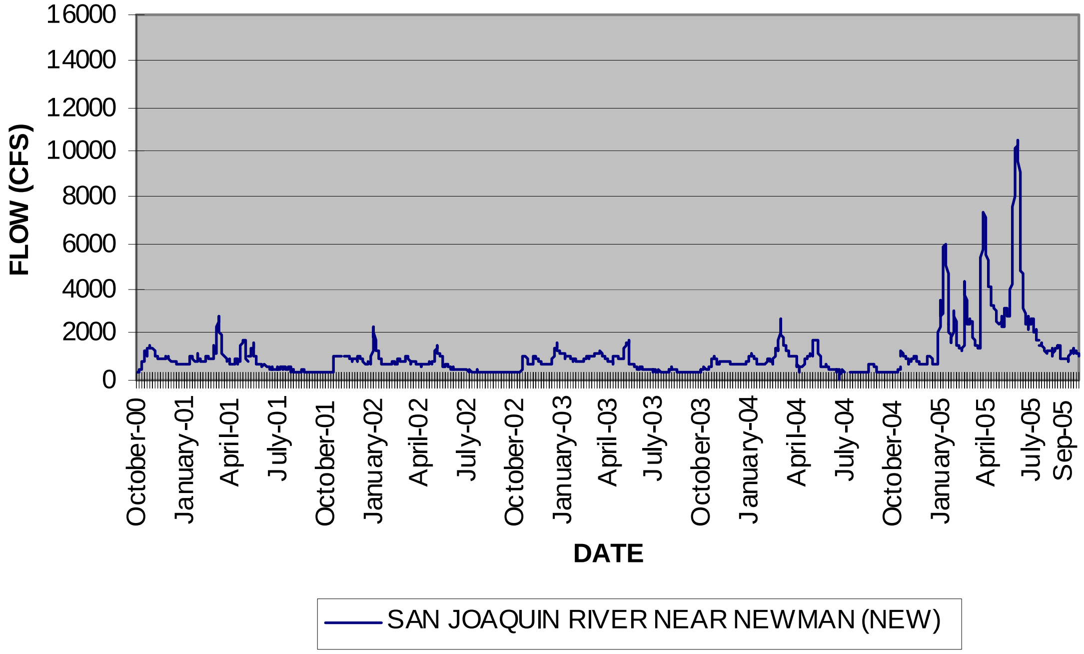
Figures 4, 5, and 6 display the mean daily flow for the Merced River and the San Joaquin River near Newman and Vernalis during this project. These sites represent the main flows coming in and out of the San Joaquin River watershed: the Merced River represents flow from the Sierras, Newman represents the upstream flow of the SJR and Vernalis represents the downstream flow from the SJR entering the Sacramento-San Joaquin Delta.

Figure 4: Merced River Near Stevinson (MST) Mean Daily Flow



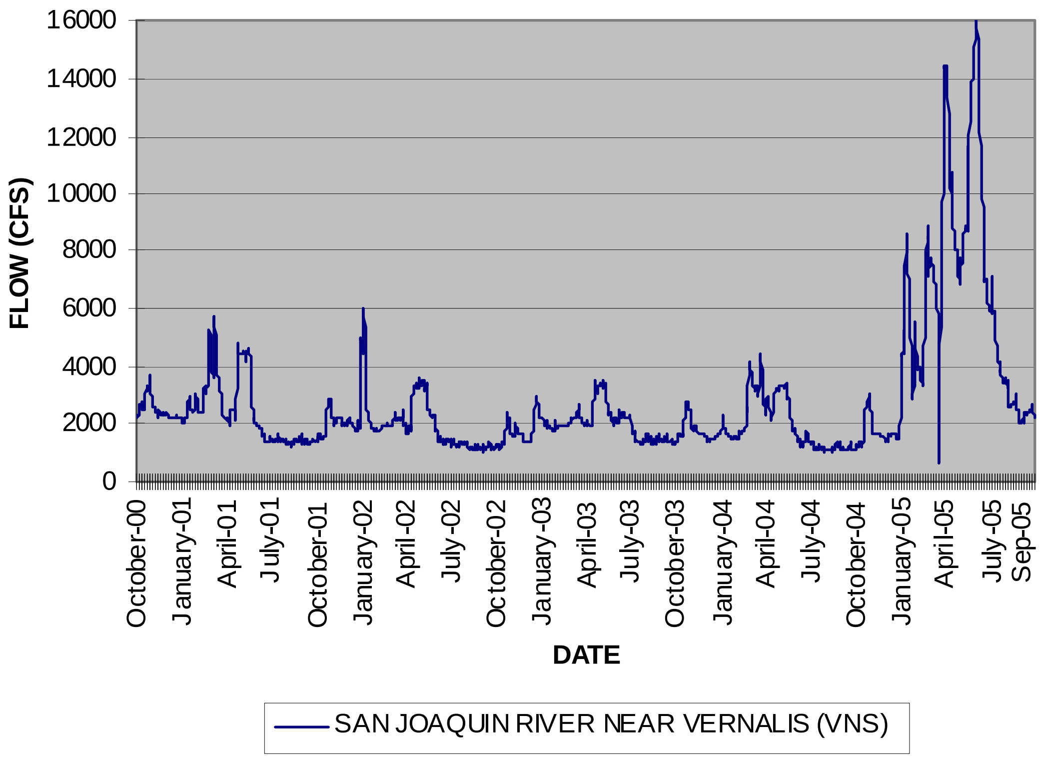
(Data Source, DWR-California Data Exchange Center (CDEC))

Figure 5: San Joaquin River Near Newman (NEW) Mean Daily Flow



(DATA SOURCE, DWR-CALIFORNIA DATA EXCHANGE CENTER (CDEC))

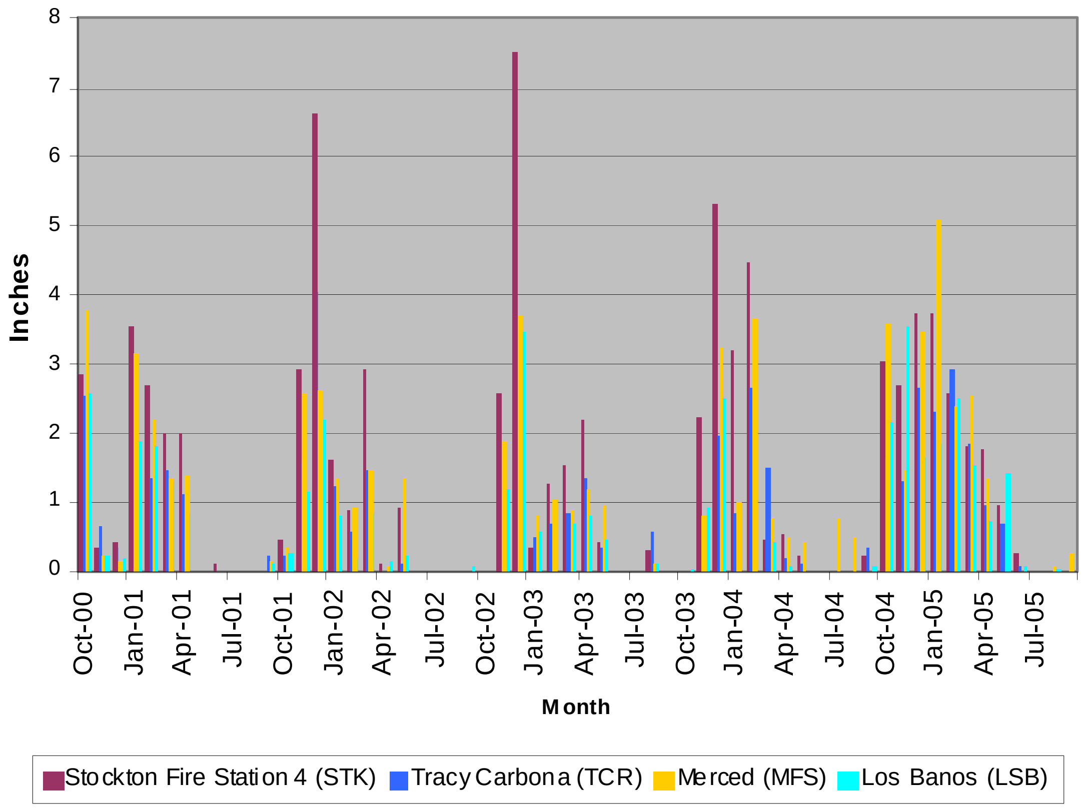
Figure 6: San Joaquin River Near Vernalis (VNS) Mean Daily Flow



(DATA SOURCE, DWR-CALIFORNIA DATA EXCHANGE CENTER (CDEC))

Figure 7 displays the San Joaquin River Watershed Monthly Rainfall Data during the project. These sites represent precipitation throughout the basin and were chosen for their extensive reliable record.

Figure 7: San Joaquin River Watershed Monthly Rainfall Data Water Year 2001-2005



(Data Source, DWR-California Data Exchange Center (CDEC))

9.0 BENEFICIAL USES AND APPLICABLE WATER QUALITY OBJECTIVES AND GOALS

One component of the Central Valley Water Boards SWAMP efforts is to evaluate ambient water quality to determine whether there is any indication that beneficial uses are being impacted. Information gathered during this study allowed analysis of a broad spectrum of water bodies at key integrator sites in order to determine existing quality at the site itself and allow some inference of the water quality within identified sub-basins. Potential beneficial uses applicable to each site monitored were identified using the designated listing from the Sacramento/San Joaquin Water Quality Control Plan (Basin Plan) (CVRWQCB, 1998). To evaluate potential impact, indicators were chosen for five broad beneficial uses: drinking water (salt, TOC, trace elements, nutrients, bacteria); aquatic life (pH, temperature, dissolved oxygen, turbidity, and water column toxicity); irrigation water supply (salt); recreation (bacteria); and waterfowl (selenium). Selenium was not assessed in this report due to the in-depth analysis of the same data through the Grassland Bypass Project. Not all of the indicators could be monitored at each site, due to funding limitations, but at least one indicator for each beneficial use evaluated was included at each site for the study.

The following two sections highlight: 1) the beneficial uses that apply to each of the water bodies sampled; and 2) the objectives and goals that were utilized when evaluating results to determine whether there was any indication that water quality was not supporting a specific beneficial use.

9.1 Applicable Beneficial Uses

In the SJR Basin, all natural water bodies have potential municipal and industrial supply designated through the statewide Sources of Drinking Water Policy (State Water Resources Control Board Resolution No. 88-63). Other specific beneficial uses have been designated to individual water bodies as well as the San Joaquin River/Sacramento-San Joaquin Delta—to which the entire SJR Basin drains. The beneficial uses of any specifically identified water body generally apply to its tributary streams.

The applicable beneficial uses for each sampling site have been summarized in Table 4, under the general headings of Drinking Water, Recreation Use, Irrigation Supply and Aquatic Life. Table 4 indicates whether the use has been specifically designated or is being applied as a tributary. Appendix Q3 provides more detail on the subcategories of use that have been specifically designated in the Sacramento-San Joaquin Basin Plan.

9.2 Applicable Water Quality Objectives and Goals

Water quality information collected during this study was evaluated using water quality objectives adopted in the Sacramento River and San Joaquin River Basin Plan (CVRWQCB, 1998), a compilation of water quality goals identified by state and federal agencies (Marshack, 2003) and targets developed by the Bay-Delta Authority (CFBDP, 2000). The Basin Plan objectives are enforceable criteria that are linked to protecting designated beneficial uses such as domestic, municipal, agricultural and industrial supply, recreation, and preservation and enhancement of fish, wildlife and other aquatic resources. These objectives are both numeric and narrative and may be specific to certain reaches of various water bodies or apply to entire basins.

The water quality goals are scientifically defensible numeric criteria developed by diverse agencies to protect specific uses; primarily aquatic life, drinking water, and irrigation supply. In many cases, the goals are national guidelines. These goals may be used to determine compliance with some of the narrative Basin Plan objectives (e.g. toxicity).

Both the objectives and the goals apply to the indicators used to evaluate beneficial use protection. A summary of the general groups of indicators that can be utilized to evaluate a beneficial use and the most limiting use (e.g. if the objective/goal is met for that use than it would be met for the remaining uses) is listed in Table 3.

Appendix Q1 lists the applicable Basin Plan objectives for this study. For turbidity, pH, temperature, and total suspended sediment, the listed objectives refer to changes impacting “normal” and “natural” conditions. For this study, natural conditions have been assumed to be conditions at the furthest upstream sampling location or upstream of a specific discharge. Appendix Q1 also includes targets identified by the Bay-Delta Authority (a joint State and Federal agency) to protect fish passage (temperatures not to exceed 20-degrees Celsius) and drinking water (total organic carbon to remain below 3.0-mg/L). Appendix Q2 shows the applicable goals sorted by generalized beneficial uses.

Table 3: Indicators and Beneficial Uses

INDICATOR(S)		SJR BENEFICIAL USE(S) Drinking Water	Aquatic Life	Irrig. Water Supply	Rec. Use
Water Column Analyses					
SC		X	X	X	
pH		X	X	X	
Temp.			X		
DO			X		
Turbidity		X	X	X	
Minerals			X	X	
Trace Elements (Total & Diss.)		X	X	X	f
Nutrient Scan		X	X	X	
TSS		X	X	X	X
TDS		X		X	
TOC		X	X	X	
BOD			X		
Bacteria		X		X	X
Toxicity					
P. promelas	96 hr	X	X	X	X
C. dubia	48 hr	X	X	X	X
S. capricornutum	Acute	X	X	X	X
P. promelas	Chronic	X	X	X	X
C. dubia	Chronic	X	X	X	X

f=Major recreational use concern is in fish consumption
Minerals= B, Ca, Cl, CO3, HCO3, K, Mg, Na, SO4, Alkalinity, TDS, Total Hardness, pH, Conductivity
Trace Elements (Total & Diss.)= As, Cd, Cr, Cu, Hg, Ni, Pb, Zn,
Nutrient Scan= K, P, PO4, NH3-N, NO3, TKN
= Most limiting beneficial use(s). For reference of actual numerical values of water quality objectives see "*A Compilation of Water Quality Goals*" (Marshack, 2000)

Table 4: Applicable Beneficial Uses

SITE SPECIFIC MONITORING BY PROGRAM AND SUB-AREA BASIN	Site ID	Drinking Water	Irrigation	Recreation			Aquatic Life						Designated (D) or Tributary (T)
				REC-1		REC-2	Freshwater Habitat		Migration		Spawning		
		Municipal and Domestic Supply (MUN)		Contact	Canoeing and Rafting	Other Noncontact	Warm	Cold	Warm	Cold	Warm	Cold	
MAIN STEM SAN JOAQUIN RIVER													
SJR @Sack Dam	541MAD007	P	E	E	E	E	E		E	E	E	P	D
SJR @ Lander	541MER522	P	E	E	E	E	E		E	E	E	P	D
SJR @ Fremont Ford	541MER538	P	E	E	E	E	E		E	E	E	P	D
SJR @ Hills Ferry	541STC512	P	E	E	E	E	E		E	E	E	P	D
SJR @ Crows	535STC504	P	E	E	E	E	E		E	E	E		D
SJR @ Patterson	541STC507	P	E	E	E	E	E		E	E	E		D
SJR @ Maze	541STC510	P	E	E	E	E	E		E	E	E		D
SJR @ Airport Way/Vernalis	541SJC501	P	E	E	E	E	E		E	E	E		D
DRAINAGE BASIN INFLOWS TO SJR													
North East Basin													
Cosumnes River @ Twin Cities Rd.	531SAC001	E	E	E	E	E	E	E	E	E	E	E	D
Mokelumne River @ New Hope Rd.	544SAC002		E	E	E	E	E	E	E	E	E	E	D
Pixley Slough @Davis Rd. *	544SJC507	E	E	E		E	E	E	E	E	E		T
Bear Creek @Thornton Rd (J8) *	544SJC508	E	E	E		E	E	E	E	E	E		T
Bear Creek @Lower Sacramento Rd. *	531SJC515	E	E	E		E	E	E	E	E	E		T
Eastside Basin													
Lone Tree Creek *	531SJC503	E	E	E		E	E	E	E	E	E		T
French Camp Slough @ Airport *	531SJC504	E	E	E		E	E	E	E	E	E		T
Merced River Hatfield Park (River Road)	541MER546	E		E	E	E	E	E	E	E	E	E	D
Turner Slough @ 4th Avenue *	535MER576	P	E	E	E	E	E		E	E	E	P	T
TID 5 (Harding Drain)*	535STC501	P	E	E	E	E	E		E	E	E		T
Tuolumne River @ Shiloh	535STC513	P	E	E	E	E	E	E		E	E	E	D
Stanislaus River @Caswell	535STC514	P	E	E	E	E	E	E		E	E	E	D
Southeast Basin													
Lone Willow Slough *	545MAD006	P	E	E	E	E	E		E	E	E	P	T
Bear Creek @ Bert Crane Rd. *	535MER007	P	E	E	E	E	E		E	E	E	P	T
Deep Slough Green House Rd. *	535MER577	P	E	E	E	E	E		E	E	E	P	T
Grassland Basin													
Discharge from San Luis Drain (SLD)*	541MER535		L	E		E	E				E		T
Mud Slough (upstream of SLD)	541MER536		L	E		E	E				E		D
Mud Slough (Downstream of SLD)	541MER542		L	E		E	E				E		D
Salt Slough @Lander/Hwy 165	541MER531		E	E		E	E				E		D
West Side Basin													
Orestimba Creek @ River Rd. *	541STC019	P	E	E	E	E	E		E	E	E		T
Solado Creek @ Hwy 33 *	541STC515	P	E	E	E	E	E		E	E	E		T
Del Puerto Creek @Vineyard *	541STC516	P	E	E	E	E	E		E	E	E		T
Grayson Drain *	541STC030	P	E	E	E	E	E		E	E	E		T
Ingram Creek @River Rd. *	541STC040	P	E	E	E	E	E		E	E	E		T
Hospital Creek @River Rd. *	541STC042	P	E	E	E	E	E		E	E	E		T
Delta Basin													
New Jerusalem Drain*	544SJC501		E	E		E	E	E	E	E	E		T
Tom Payne Slough @Paradise Rd.	544SJC505	E	E	E		E	E	E	E	E	E		D
Old River @Tracy Blvd	544SJC506	E	E	E		E	E	E	E	E	E		D
Mt. House Creek @ Mt. House Parkway	S544SJC509	E	E	E		E	E	E	E	E	E		T

* = Beneficial uses not specifically designated, therefore current listing based on downstream beneficial use
E = Exisiting beneficial uses
P = Potential beneficial uses
L=Existing Limited Beneficial Use